PATENT SPECIFICATION 1 226 483

DRAWINGS ATTACHED

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(54) BRAKING SYSTEM FOR CENTRIFUGAL SEPARATORS AND SEPARATORS INCORPORATING SUCH A SYSTEM

(71) We, WESTFALIA SEPARATOR A.G., a German Body Corporate, of 4740 Oelde, Westfalen, Postfach 4 und 6, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to centrifugal separators and is concerned with braking the systems of such separators.

Modern centrifugal separators are equipped with brakes in order to shorten the long running down times of the drum, which represent pure loss times. Under certain conditions a large amount of damage can be avoided with rapid braking of the drum. This is for example the case when an imbalance occurs and the whole machine begins to vibrate. In association with other measures of a technical operation nature, e.g. in the washing through of the drum, it is advantageous to reduce temporarily the rate of revolution of the drum by braking.

The aim of the invention is to create a particularly effective braking device for separators in order to bring the drum to a standstill as quickly as possible, or to bring the drum to a greatly reduced rate of revolution.

Brakes are known, which are arranged on the fixed separator frame, which are operated manually, electromagnetically or also pneumatically, and which act mechanically on the rotating drum or on a brake plate fixed on the counter-shaft.

It is also known to reverse the rotational field of a polyphase induction motor used for the drive by changing the poling of two phases, and to allow the motor to act as counter-current brake.

Mechanical brakes have the disadvantage that they wear out, and also cause wear and tear of the braked part. Polyphase induction motors which are also to be used as counter-current brakes, must have a design of appropriate thermal technical nature. They are therefore considerably more expensive.

With both types of brakes, large quantities of heat are also developed, which cannot be dispersed rapidly enough, and which therefore lead to overheating.

In order to avoid these disadvantages of the known brakes, a hydrodynamic brake has already been proposed, which consists of a ring having U-shaped cross-section, into which there protrudes a ring plate as braking element and a supply line for the brake fluid, whereby either the ring or the braking plate is fixed to the rotating drum and the other part is fixed to the stationary separator frame. Such a hydrodynamic brake is described and claimed in the present Applicants' Specification No. 41477/69 (Serial No. 1 223 396).

It has now been shown that a hydrodynamic brake has a completely different characteristic to a mechanical brake or a counter-current brake. Whilst the known brakes have a linear characteristic, that of a hydrodynamic brake is almost hyperbolic. In the known brakes, the reduction of the rate of revolution is thus constant in the same intervals of time. With a hydrodynamic brake it is very much greater in the first phase of the braking process, in order to decrease more and more. In the range of higher rates of revolution, a hydrodynamic brake is therefore considerably more effective than a mechanical or countercurrent brake, whilst in the range of lower rates of revolution the last-mentioned is more effective than a hydrodynamic brake.

According to the present invention a centrifugal separator has a brake assembly comprising in combination a hydrodynamic brake and a mechanical and/or countercurrent brake, arranged so that at the commencement of braking, at least the hydro-

dynamic brake is operative and subsequently at least the mechanical or counter-current brake is operative.

The invention may be performed in many ways and one specific embodiment will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a schematic elevation of a centrifugal separator according to the present invention, having a hydrodynamic brake, and a mechanical and an electrical brake, and

Figure 2 is a graph showing the relationship between rotational speed and time using various types of brake.

In Figure 1 the separator comprises a stationary supporting frame indicated generally at 1 supporting a rotatable drum indicated generally at 2. A U-shaped or channel section ring 3 is secured to the base of the drum 2 and a brake plate indicated generally at 4 is fixed to the stationary frame 1. The ring 3 is open at its inner periphery and the brake plate 4 is provided with a flange 4A which extends into the section of the ring. Brake fluid is arranged to be supplied to the stationary plate 4 under pressure through a pipeline indicated at 5. In operation, when the drum is to be braked a valve 6 is opened, as more fully described hereafter, brake fluid is sprayed under pressure against the base of the drum 2 and is centrifuged out into an annular chamber 7 formed by the section of the U-shaped ring 3. The chamber 7 is provided with one or a number of bores 8 which lead outwards so that the chamber 7 empties automatically when the supply of brake fluid is stopped. If desired, the brake plate 4 can be provided with ribs or the like. Depending upon the quantity of brake fluid supplied the chamber 7 fills with fluid to a greater or lesser extent so that with the aid of the valve 6 the degree of braking can be regulated.

The centrifugal separator is also equipped with a mechanical brake indicated generally at 10. This mechanical brake is of conventional construction and comprises a brake shoe indicated at 11 which is arranged to be operated by a magnetic coil 12 and when so operated engages against the side of the drum 2 to retard it.

In operation when the drum 2 of the separator is to be braked a switch S in an electric circuit is closed by the operator. This is arranged to open the valve 6, which is magnetically operated by energising its operating magnet M, so that fluid is supplied through the pipeline 5 and is sprayed against the drum. A time relay T is also set into operation when the switch S is closed, the relay being arranged to be operative after a predetermined time interval. When the set time has passed the relay is arranged to close a contact t_1, which in turn operates the magnetic coil 12 to engage the brake shoe 11 against the drum.

A counter-current brake may also be used either instead of or in addition to the mechanical brake. In this case the switch S is operated as before by the operator and again actuates the time relay T. After the predetermined time has elapsed the time relay is arranged to close contact t_1 as above and/or to move contacts t_2 and t_3 which are arranged to switch over phases L_1 and L_2 of the lines leading to the drive motor. Thus a reversal of the rotational field is effected and hence braking takes place by counterflow of current. In this case when the drum has reached a standstill an arrangement is incorporated to open the switch S again so that the drum will not begin to rotate in the opposite direction.

In another embodiment the mechanical brake 10 may be arranged to be actuated manually to operate during any part of the braking operation.

The characteristics of a hydrodynamic brake, a counter-current brake and various time combinations are illustrated graphically in Figure 2.

A drum filled with liquid and rotating at 4500 r.p.m. was braked with a counter-current brake. Curve A is the characteristic of this brake. The drop of the rate of revolution is constant in the same time intervals and is approximately 800 r.p.m./Min. After 5.6 minutes, standstill of the drum was achieved. A mechanical brake used as a comparison had practically the same characteristic.

Curve B is the characteristic of a hydrodynamic brake, which was supplied with constant quantity of brake fluid. Its path is almost hyperbolic. In the first 30 seconds, it brought the drum to almost half the rate of revolution but after this it became steadily less effective. The drum ran slowly down and had come to a standstill after 10 minutes.

At the point P, the curve B was approximately as steep as the curve A. This point was reached after 1.5 minutes. The rate of revolution of the drum was at this time still 1320 r.p.m. In a subsequent test, the hydrodynamic brake was switched off and the counter-current brake switched on at this time. The further path of the curve B is designated with C. For the braking of 1320 r.p.m. the counter-current brake requires 1.65 minutes, so that after a total of 3.15 minutes the standstill of the drum was reached, as the diagrams shows. With the rate of revolution of 1320 r.p.m. the rotational energy of the drum is however only 8.6% of that which it possesses at 4500 r.p.m. The counter-current or mechanical brake

thus only has to perform a small amount of work in the final phase of the braking process, so that the disadvantages associated with them in general operation are to a very great extent avoided.

Curve D shows the path of the rate of revolution in dependence upon the time when hydrodynamic brake and counter-current brake are in operation during the total braking time. As can be seen from the course of the curve, the hydrodynamic brake has no more recognisable influence in the end phase. The last part of the curves D runs practically parallel to the curve C or A.

WHAT WE CLAIM IS:—

1. A centrifugal separator having a brake assembly comprising in combination a hydrodynamic brake and a mechanical and/or counter-current brake arranged so that at the commencement of braking at least the hydrodynamic brake is operative and subsequently at least the mechanical or counter-current brake is operative.

2. A centrifugal separator as claimed in Claim 1 in which at least the mechanical or counter-current brake is arranged to be in operation at the termination of braking.

3. A centrifugal separator as claimed in Claim 1 or Claim 2 in which a time controlled switch is arranged to be brought into operation at the initiation of braking and is adapted to operate the mechanical or counter-current brake after a predetermined interval.

4. A centrifugal separator substantially as described herein with reference to the accompanying drawings.

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2 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

FIG. 1

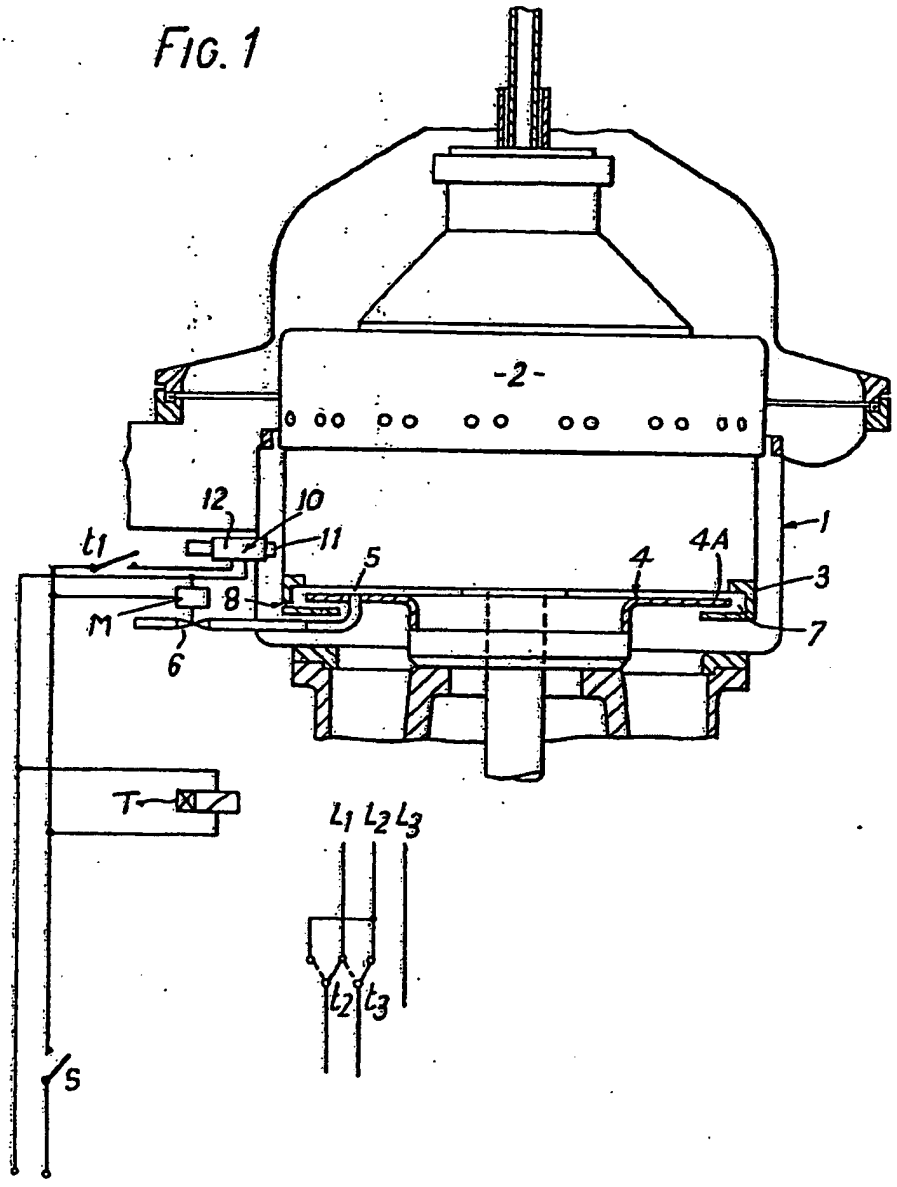

FIG. 2